

COS402- Artificial Intelligence

Fall 2015

Lecture 4: Search in Games

Outline

- **Games we are looking at**
 - **2-player game**
 - **Zero-sum game**
- **The Minimax algorithm**
- **Alpha-beta pruning**
- **The Minimax algorithm extends to multiplayer game**

Some points

- **The Minimax value of a node**
 - **The utility (for Max) of being in the corresponding state if both players play optimally from there to the end of the game.**
- **Alpha-beta pruning**
 - **Alpha: the value of the best choice we have found so far at any choice point along the path for MAX. (i.e. highest-value)**
 - **Beta: the value of the best choice we have found so far at any choice point along the path for MIN. (i.e. lowest value)**

Some points--more

- **Evaluation function**
 - **Needed when building/searching a complete game tree is impossible**
 - **An estimate of the utility of nodes at the cutoff level**
 - **Usually a functions of features of the state**
- **When to cut off**
 - **Go to fixed depth?**
 - **Iteratively increase depth until time runs out?**
 - **Other strategies?**

Review questions: true or false

1. **Zero-sum means the total payoff of the two players at the end of a game is always zero no matter how the game ends.**
2. **The Minimax algorithm is optimal because it explores all possibilities and return the Minimax value of the root node.**
3. **If both players play optimally, other algorithms will not return a better utility of a node than the Minimax algorithm.**
4. **Time complexity of the Minimax algorithm is $O(b^m)$ because it checks every node in the game tree. (b is the branching factor and m is the maximum depth of leaf nodes.)**

Review questions: true or false (cont'd)

5. **Space complexity of the Minimax algorithm is $O(b^m)$ because it checks every node in the game tree. (b is the branching factor and m is the maximum depth of leaf nodes.)**
6. **The Minimax algorithm can be extended to a multiplayer game as long as it is a zero-sum game.**
7. **Alpha-beta pruning is optimal because it only cuts off the subtrees that will not affect the Minimax value at the root.**
8. **Alpha-beta pruning can be extended to multiplayer games and it can significantly reduce the number of nodes searched.**

Announcement & Reminder

- **P1 (first programming assignment) will be released today. It is due on Tuesday Oct. 13th.**
 - due by midnight, upload your files to CS dropbox
- **W1 is due on Tuesday Oct. 6th (exactly one week from today)**
 - Due in class, hard copies.